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CONTROL OF WIREWORMS ON IRRIGATED LANDS IN THE PACIFIC NORTHWEST

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The problem of controlling wireworms in the Pacific Northwest is one upon which considerable effort has been expended during the past several years. Intensive investigations into the life history of wireworms and their behavior in the soil have been made with the object of finding methods by which they can be controlled. As a result, four direct measures for the control of wireworms are being offered for trial at this time. Two of these comprise the use of chemicals--carbon disulphide and crude naphthalene--which act as fumigants to kill wireworms in the soil. The other two control measures are based on cultural methods, which would obviate the expense of fumigants and consequently be of more practical use to the average farmer. These cultural methods are based on the fact that wireworms can be killed by producing either an excess or a deficiency of moisture in the soil during the summer season; that is, by flooding or by drying out the soil containing the wireworms. It is believed that these cultural methods of water manipulation in the soil will eventually become of great practical value in controlling wireworms on the irrigated lands.

Carbon disulphide.--When carbon disulphide is used, the ground to be treated should be plowed deeply, smoothed lightly afterwards, and marked off in 2-foot squares. At the intersection of the marks, holes should be punched with a stick to a depth of three or four inches. Apply 1 fluid ounce of carbon disulphide in each hole and immediately cover it with soil, pressing it down tightly with the foot. After five days, plow the soil deeply again and prepare for planting. One 100-pound (10-gallon) drum of carbon disulphide will treat approximately 5,000 square feet and will cost about \$8.50.

CAUTION: Liquid carbon disulphide evaporates very rapidly upon exposure to the air, and the vapor is extremely inflammable and explosive when mixed with air in certain proportions. It should therefore be kept in a cool place and handled with great care. Do not smoke when handling it.

Naphthalene.--When crude naphthalene is used, it is recommended that the ground be plowed as deeply as possible (10 to 12 inches), three fourths of the finely ground naphthalene being sprinkled at the same time along the sides of the furrow. The remaining one fourth should be sprinkled on top after the plowing is finished, and the whole field immediately disked as deeply as possible in order thoroughly to mix the naphthalene with the soil. Smoothing the top soil after disking will help to keep the naphthalene gas in the soil. Better distribution of the material can be accomplished by grinding or sifting the crude naphthalene to fine particles and then mixing it with dry soil in equal parts by weight. It appears necessary to use at least 800 pounds of crude naphthalene per acre to obtain a good kill of wireworms. After five days the gas from the naphthalene will have accomplished its greatest kill of wireworms, and seed can be planted with little risk of injury. The cost of naphthalene is about 3 cents per pound, at which rate it would cost about \$24.00 for the material to treat an acre.

It is important that the temperature of the soil be at least above 70° F. during the period of treatment and that the soil be in a good tillable condition, if the best diffusion of gas is to be obtained with either carbon disulphide or naphthalene. This practically limits the use of these materials to the months of June, July, and August, in the Pacific Northwest.

Flooding.--In the presence of excessive moisture, wireworms become inactive, and at low temperatures they can exist for months under water or in flooded soil. However, if the temperature of the water rises above 70° F. the wireworms will begin to die; and if this temperature is maintained for a period of five to seven days a high percentage of them will be killed. These high temperatures are most likely to occur out of doors during July and August, when periods of hot sunny weather usually occur. The land infested with wireworms should be loosened by plowing, then leveled and diked at intervals, so that the water depth will not be over a few inches at any place. At about the time a hot period is expected a shallow layer of water should be turned into the diked areas and maintained for a period of a week. The temperatures of the soil under the water should be checked frequently, and if an average of 75° F. or higher is found at a depth of 6 inches for the period of flooding, a good kill of wireworms can be expected. Flooding kills all stages of wireworms, including the pupae and adult beetles. The principal drawback to this method of controlling wireworms is that it can be used only on fairly level fields when plenty of water is available for at least a week and in fields not in crop during the period of flooding. It is especially adapted to ridding soil of wireworms in the more intensive truck gardening sections, where the land is generally fallow in the summer between the spring and fall crops.

Drying:--Investigations into the life processes of wireworms under controlled conditions in the laboratory have brought out the fact that wireworms cannot survive in relative humidities of less than 100 percent. Stating this in terms of soil water, wireworms cannot live in soils that are too dry to support plant life. In order to dry out soil sufficiently to kill wireworms, deep rooted crops such as wheat and alfalfa should be grown without irrigation during the entire season. Only in this way can the top 18 inches of soil be dried out sufficiently to kill the wireworms therein. Drying is especially adapted to lands of sandy-loam type where the water table does not come nearer than 3 feet of the soil surface in the summer. Apparently the wireworms do not escape from the upper dry soil layers by downward migration. This method of controlling wireworms will take weeks, as compared to days in the flooding method, but it will probably fit in better with ordinary farm practices in the irrigated districts. The farmer will have to plan on a reduction in his yield of grain or alfalfa, but he should be able to harvest a partial crop if the normal spring rainfall is received. The wheat stubble should be left after harvest and the ground should not be disturbed before the first of September. At this time the land could be plowed and the usual procedure for growing truck crops the following season be carried out. If this drying-out process can be fitted into rotation so that any field that is likely to be badly infested with wireworms is dried out once every fifth or sixth year, the wireworm population will be kept to a minimum and little damage to crops will ever occur.

These recommendations for flooding and drying out soil to control wireworms should be adapted to the individual conditions of the particular field to be treated. Small plots that are heavily infested can be flooded for a short period in summer and the wireworms practically eliminated. On the other hand, large areas not adaptable to flooding can be dried out; however, this method means that the crop yield will be greatly reduced because of the lack of water.

In conclusion it might be stated that none of these controls for wireworms is an every-year treatment. The long life cycle of the wireworms (four years on the average) and the fact that re-infestations occur only by deposition of eggs in the spring, preclude their increase to damaging numbers in less than three or four years. Under unfavorable spring weather or soil conditions it might be even longer between necessary control treatments.

